CHEMISTRY OF WOOD
VIII. Further Studies of Sapwood and Heartwood

June 1926

UNIV OF FLA LIB
DOCUMENTS DEPT
U.S. DEPOSITORY

No. R917

SCHOOL OF FORESTRY LIBRARY
UNIVERSITY OF FLORIDA

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
FOREST PRODUCTS LABORATORY
Madison, Wisconsin
In Cooperation with the University of Wisconsin

Digitized by the Internet Archive
in 2013

http://archive.org/details/woodf00fore

CHEMISTRY OF WOOD[1]

VIII.--Further Studies of Sapwood and Heartwood

By

G. J. RITTER, Chemist
and
L. C. FLECK, Associate Chemist

The present paper represents a continuation of a previous study of the chemistry of sapwood and heartwood[2] to determine whether any additional generalizations can be made in grouping hardwoods and softwoods on the basis of chemical differences between sapwood and heartwood. The methods of analysis are identical with those used in former experiments of this series.[3] The determinations were made in duplicate, and the average of each pair of determinations is shown in the accompanying table.

Discussion of Results

The results confirm the conclusions stated in the sixth paper[2] of this series, to the effect that softwoods form a single group having high relative amounts of extractives in the heartwood. Also, with only one exception, the softwoods here reported exhibit another characteristic in common with those reported in paper VI, in that the high extractives in the heartwood are accompanied by low percentages of lignin and cellulose. In the exceptional case of white spruce the lignin and cellulose content is approximately the same in sapwood and heartwood. The hardwoods, also in accord with the findings of the earlier paper,[2] are distributed between two groups having high relative amounts of extractives in the sapwood and heartwood, respectively.

The acetic acid obtained by acid hydrolysis is uniformly higher in the sapwood than in the heartwood of both hardwoods and softwoods.

By the results here reported more species have been fitted into the scheme of classification advanced in the sixth paper of the series.

---

[1]Presented before the Division of Cellulose Chemistry at the 66th meeting of the American Chemical Society, Milwaukee, Wis., Sept. 10 to 14, 1923.

[2]Industrial & Engineering Chemistry, 15, 1055 (1923).

[3]Ibid., 14, 1050 (1922).

Whether additional groups of softwoods exist is a question that can be answered only after a larger number of species have been analyzed. Combining results for the hardwoods listed in the sixth and the present paper, it is seen that Group A (with high extractives in the sapwood) includes white ash, pignut hickory, red alder, red mulberry, sugar maple, and catalpa; Group B (with high extractives in the heartwood) includes yellow-poplar, yellow birch, white oak, red oak, locust, and eucalyptus.

Conclusions

1. In softwoods the water, ether, and alkali extracts are higher in the heartwood than in the sapwood, and the cellulose and lignin are correspondingly lower in the heartwood (except in white spruce, in which cellulose-lignin content is approximately the same in the two bands of growth).

2. On the basis of water, ether, and alkali extractives, hardwoods are divided into two groups: (a) those with high extractives in the sapwood, and (b) those with high extractives in the heartwood. The former have low cellulose in the sapwood, the latter low cellulose in the heartwood.

3. Acetic acid by hydrolysis is higher in the sapwood than in the heartwood of all the woods.

Analyses of Sapwood and Heartwood of Some American Woods

(Results in percentage of oven-dry (105° C.) samples)

Species	Sample	Moisture	Ash	Solubility in: Cold water	Hot water	Ether	1% NaOH	Acetic acid	Methoxyl	In Cellulose: Pentosan	Methyl pentosan	Cellulose	Lignin	Pentosan	Methyl pentosan	Alpha	Beta	Gamma
Hemlock:																		
Sapwood	219	6.39	0.37	1.16	2.28	0.34	10.93	1.83	4.95	8.79	3.59	51.76	31.82	5.32	2.01	45.39	33.85	20.76
Heartwood	220	6.90	0.51	4.12	5.36	0.70	15.01	1.73	5.36	9.06	2.76	52.83	30.30	4.37	4.31	48.17	22.66	29.17
Redwood:																		
Sapwood	231	6.69	0.27	4.28	6.50	1.95	15.54	0.99	5.28	10.04	2.80	46.35	33.98	6.62	1.07	52.20	35.05	12.75
Heartwood	232	7.53	0.14	10.53	14.39	2.07	25.85	0.48	5.11	8.86	2.08	41.54	31.82	6.54	1.46	56.18	31.02	12.80
White spruce:																		
Sapwood	500	6.59	0.28	1.54	1.99	....	10.83	1.74	4.11	12.84[a]		59.30	26.71	8.54[a]		...	...	...
Heartwood	501	5.37	0.26	2.38	3.31	....	11.83	1.64	4.37	13.63[a]		59.45	26.93	9.47[a]		...	...	...
Red alder:																		
Sapwood	201	5.02	0.32	4.28	5.35	1.03	20.16	3.53	5.29	20.81	1.13	56.36	25.97	20.98	0.72	42.02	35.53	22.45
Heartwood	202	6.82	0.45	3.97	5.21	1.39	20.01	3.50	5.33	21.03	1.20	57.41	26.68	20.80	0.82	49.19	29.82	20.99
Sapwood	203	5.77	0.24	3.49	4.75	0.90	20.25	3.69	5.27	20.76	1.47	57.28	26.64	19.30	1.13	40.93	37.44	21.65
Heartwood	204	3.70	0.23	3.31	4.67	0.77	21.61	3.40	5.26	20.51	1.91	57.75	26.94	20.23	1.79	38.67	38.50	22.83
Red mulberry:																		
Sapwood	223	5.82	1.03	9.12	12.56	1.75	29.08	4.07	4.24	21.16	1.86	47.80	22.76	22.81	1.21	75.51	15.80	8.69
Heartwood	224	5.82	0.48	7.08	10.20	1.71	27.58	3.63	4.47	20.28	1.68	48.56	24.00	23.03	2.04	57.72	25.77	16.51
Sugar maple:																		
Sapwood	225	5.80	0.31	3.05	4.15	0.58	19.21	3.79	5.78	20.50	2.06	56.29	25.37	20.18	1.48	63.82	13.49	22.69
Heartwood	226	5.71	0.66	2.19	3.15	0.58	19.18	2.23	5.88	20.42	1.56	56.47	27.37	20.57	1.38	66.83	12.62	20.55
Catalpa:																		
Sapwood	227	3.95	0.53	6.55	9.37	0.93	28.11	4.59	4.83	22.75[a]		55.79	21.06	22.83[a]		72.25	18.35	9.40
Heartwood	228	3.90	0.34	6.46	9.24	0.71	28.56	4.37	4.38	22.54[a]		55.99	20.90	22.86[a]		71.41	17.86	10.73
Red oak:																		
Sapwood	229	4.14	0.14	3.57	6.13	1.24	22.04	5.08	6.05	21.88	1.87	53.98	24.47	22.46	1.69	70.18	13.22	16.60
Heartwood	230	3.78	0.18	5.74	8.29	1.23	24.10	3.67	5.98	20.95	1.69	53.58	23.12	22.68	2.00	72.13	12.10	15.77
Locust:																		
Sapwood	221	5.08	0.55	3.08	3.91	0.74	17.64	3.16	4.20	21.64	1.99	60.31	23.22	21.70	0.00	65.96	24.46	9.58
Heartwood	222	6.55	0.14	8.29	11.04	1.70	25.72	2.86	4.54	20.77	1.70	52.04	23.11	24.78	0.00	44.97	38.93	16.60
Eucalyptus:																		
Sapwood	215	4.98	0.41	2.01	3.10	0.38	15.72	3.14	6.45	20.47	1.13	55.29	26.60	19.16	0.82	43.77	41.77	14.46
Heartwood	216	7.07	0.18	8.07	10.43	1.09	23.85	2.25	5.82	18.81	1.10	51.08	27.53	18.88	1.31	59.08	26.97	13.95
Sapwood	217	4.64	0.42	2.22	3.33	0.45	17.54	2.61	6.43	21.31	1.33	56.67	28.21	18.51	1.33	36.39	45.68	17.93
Heartwood	218	6.58	0.26	6.69	10.23	0.72	25.12	1.84	6.06	19.86	1.33	52.31	30.00	19.08	1.22	47.21	36.84	15.95

[a] Combined pentosans and methyl pentosans reported as pentosans.

ZM168745

UNIVERSITY OF FLORIDA
3 1262 09216 2998